Livelihoods in Dynamic Socioenvironmental Systems

Suggestions for the socio-economic perspective in the Ramsar Guidelines on agriculture-wetland interactions.

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1. Background and introduction

Wetlands and wetland agriculture have made, and continue to make, a significant contribution to the functioning of many societies around the globe. Indeed, in many parts of the world – particularly in developing countries – wetlands are vital resources for achieving food and water security and improving livelihoods (Silvius et al., 2000). Wetlands are critical reservoirs of natural capital that have traditionally been used for a wide range of livelihood activities including fishing, agriculture and the collection of forage resources (Nicholas, 1998). More recently, however, as significant numbers of countries are undergoing profound social, political and environmental transformation, wetlands and their related agricultural systems are undergoing significant changes. These changes are the result of a variety of drivers, ranging from local population pressure to international economic development. As pressures on wetland-agriculture systems continue to build, resulting in a series of changes in the state of wetlands as ecological systems, the impacts on prevailing socioeconomic conditions are far-reaching. As decision-makers make choices that concern the future of wetlands, their actions can either result in further deterioration of the wetland system, or they may entail responses which reduce mounting pressures. Whatever the situation may be, there is always a socioeconomic dimension to these actions. Different stakeholders exploit livelihood systems in diverse ways: sometimes competing wetland interests are in direct conflict with each other, but at other times, interests may be parallel to each other, encouraging cooperation within the same ecosystem.

The focus of this paper is on livelihoods within the dynamic contexts described above. Our discussion builds on the Millennium Ecosystem Assessment (MA), a four-year international process (2001-2005) which was designed to provide decision-makers with information on the links between ecosystem change and human well-being. For present purposes, we adopt the MA terminology in light of its importance as an internationally recognized reference document, but our discussion is also concerned with several key aspects of the MA[1]. Most notably, the discussion revolves around dynamic socioenvironmental systems (or the social and socioeconomic aspects of dynamic ecosystems), which is a central concept to the MA document. In this light, the title of our paper – 'Livelihoods in Dynamic Socioenvironmental Systems' – reflects some of the key ideas in the MA.

[1] The following link provides access to Chapter 3, Ecosystems and Human Well-Being: http://www.millenniumassessment.org/documents/document.301.aspx.pdf

In addition to its links to the MA report, this paper also serves as a background document in support of the construction of the Ramsar Guidelines on wetland-agriculture interactions. Ramsar resolution VIII.34 was adopted by the contracting parties in Valencia, Spain in 2002, and was subsequently reconfirmed in Kampala, Uganda in 2005, where agreement was reached on its implementation. The resolution calls for the development of a framework and a set of guidelines on agriculture-wetland interaction. A group of international experts who specialize in wetlands and related agricultural activities– referred to as the GAWI group – was assembled to generate these Guidelines. The group consists of members from IWMI, a Ramsar International Organization Partner; FAO; Wetlands International, also an International Organization Partner; Wageningen University and Research Centre, an academic institution with relevant experience; and Wetland Action, an internationally active NGO. The group is presently in the process of analyzing an extensive range of case study situations, from all corners of the globe, to understand the dynamics of wetland-agriculture systems as they present themselves in real world situations. The focus is on the responses that people develop to counteract the perceived negative developments in wetlands. It is anticipated that the result of the analysis will be an improved understanding of the dynamics of wetland-agriculture systems, and of the issues that require attention in the Guidelines that seek to support the sustainable management of such systems. These results will ultimately be presented in the Framework Document (Wood et al., 2007, forthcoming).

The subsequent step in the process of developing the Guidelines, as intended in Ramsar Resolution VIII:34, is to hold an expert's workshop at Wageningen University and Research Centre in The Netherlands between 15 -17 October 2007. At this workshop, the Guidelines will be further defined to shed light on what form they will assume, which issues will be covered, and how the information will be presented. This present paper, in conjunction with the Framework Document currently in preparation mentioned above, a second background paper on Water Management for Ecosystem Services, and a number of other supporting documents, will provide input for the discussions and decision-making process at the expert's workshop. The Guidelines themselves will be formulated and presented to the Ramsar contracting parties for comments in the years ahead, with the aim of being ready for presentation and approval at the Ramsar meeting in 2011 (location as yet unknown). At the COP X, which will be held in Seoul, South Korea, in 2008, the design of the Guidelines will be presented for approval to the Ramsar Contracting Parties. The GAWI partners plan to organize at the COP X to introduce and discuss draft Guidelines on agriculture-wetland interactions.

The present document is therefore an important step in the process of preparing the Guidelines. Ultimately, its purpose is to establish the relevance of the socio-economic dimension of agriculture-wetlands interactions to the intended Ramsar Guidelines, as well as to indicate how the socio-economic dimension should be

incorporated. As such, it is not a draft Guideline in itself, but a document that, once it has assumed its final form, is a useful preparation for a Guideline. To apply a metaphor from the world of architecture, it resembles more than a rough sketch of a building, but it is not yet a builder's estimate.

This paper is organized into five sections. Following this introduction, section two is concerned with defining the notion of livelihoods and related concepts, and a conceptual framework is presented and analyzed. Section three is vital to the subsequent material presented in this paper in the sense that it describes three socioenvironmental systems as they presently exist, but also explores how these systems are developing and evolving. The purpose of this exercise is twofold: 1) to further develop the conceptual framework presented in section two; and 2) to show the dynamics of socioenvironmental systems in practice. Three socioenvironmental systems have been selected for this purpose: 1) Lake Kolleru, Andrah Pradesh, India; 2) the small valley bottom wetlands of the Western Highlands of Ethiopia; and 3). the peat swamps of Southeast Asia. Section four presents a summary and an interpretation of the cases described in section three. Finally, in section five, suggestions are formulated for how the socioeconomic dimension should feature ultimately in the Guidelines.

2. Dynamic Socioenvironmental systems

2.1. Human well-being

Ecosystems are dynamic; their ecological components change constantly and so do the services which they deliver. The factors of chance, or drivers in the DPSIR terminology, are many, and operate at different spatial and temporal scales. They are either the cause of human activities, or are the result of natural processes. The reader is referred to Wood et al. (2007) for a more general analysis of the drivers, the pressures that result from them, and the resultant state changes of wetlands and their socio-economic impacts to wetland-dependent populations. In this paper, we explore the interactions between different wetland stakeholders and decision-makers, and more specifically, the impact that decisions in one group may have on the well-being of other groups. In this section, the conceptual framework that is used for the analyses is first explained.

The Millennium Ecosystem Assessment – and in particular the discussion in Chapter 3 which focuses on the relationship between ecosystem services and human well-being – provides a number of concepts which we will use to inform our analysis. These concepts are:

- human well-being and their determinants and constituents
- poverty
- development
- ecosystem services and their relations to human well-being
- livelihoods
- sustainability and resilience

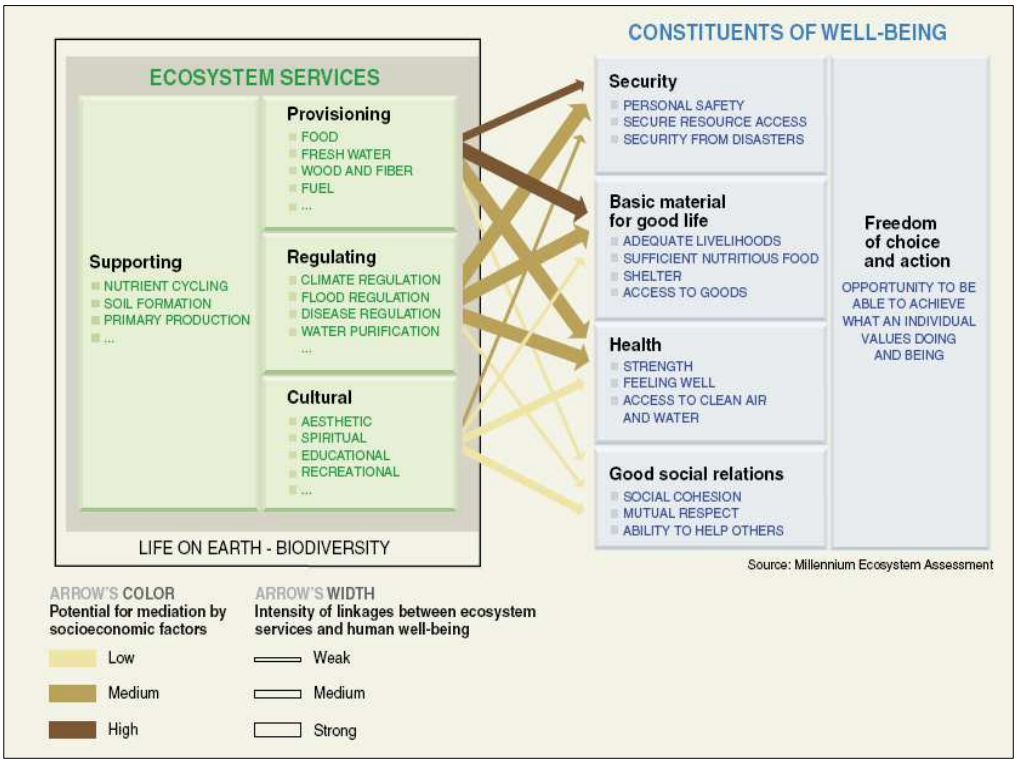
In contrast to poverty, human well-being "includes basic material needs for a good life, the experience of freedom, health, personal security, and good social relations. Together these provide the conditions for physical, social, psychological, and spiritual fulfillment" (MA, 2005: page 73) [2]. Constituents of human well-being, for example, include material inputs such as food, clean water, materials for shelter, and livestock; they are the elements that make human well-being possible. If 'development' can be considered to be the enhancement of human well-being, then it follows that poor people must lack sufficient levels of these constituents. Moreover, in the process of promoting development, trade-offs do occur – for example whether or not to consume more of an ecosystem service in order to accumulate capital. Politicians aim to make

[2] For the full text of Chapter 3, Ecosystems and Human Well-Being: a Framework for Assessment, of the Millennium Assessment, link to: http://www.millenniumassessment.org/documents/document.301.aspx.pdf

informed decisions, weighing the pro's and cons associated with development, and one important consideration which must be taken into account is the sustainability of the ecosystem. Undoubtedly, the most well-known and frequently cited definition of 'sustainable development' is that published by the World Commission on Environment and Development, the Brundtland Commission, which suggests that it is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED 1987: 43)[3].

There is a strong link between human well-being and ecosystem services. Figure 1 shows these relations. The width of the arrows is a measure of the intensity of

Figure 1. Relation between ecosystem services and human well-being



source: MA, Ecosystems and Human Well-Being, p. 78

the linkages between ecosystem services and human well-being. Clearly, the supporting and provisioning services of ecosystems contribute most to basic materials for good life and security. In this paper, the focus will be more on these relations than on the regulating and cultural services.

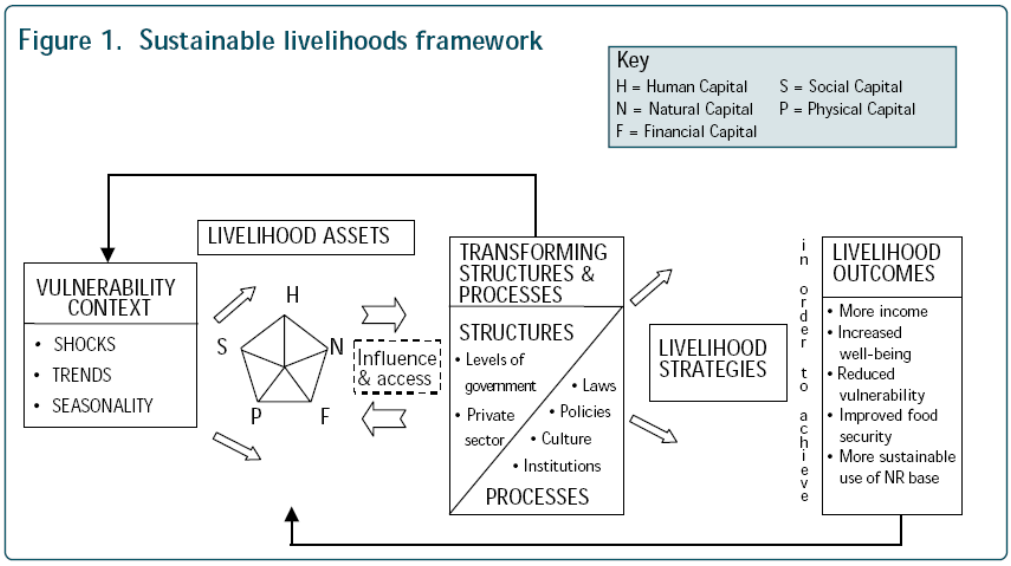
[3] It has been pointed out that this well-worn phrase may better be considered a slogan than a meaningful definition (Adams, 2001).

2.2. Livelihood systems

The livelihoods concept was developed in the early 1990s. Chambers (1989) was one of the first to introduce the concept, when he described livelihoods as "adequate stocks and flows of food and cash to meet basic needs" (Chambers, 1989. It is clear, however, that since this first definition, the concept has evolved considerably. The concept was quickly adopted by development practitioners world wide, who refined it and deducted methods to analyze stakeholder situations and systematically build up a more holistic picture of their situations. Such information was often used to design initiatives to improve the well-being of their target groups - often the poor and deprived.

Most often, the concept of livelihoods has been applied at the individual or household level. However, one of the great advantages of the livelihood concept is that it is scale neutral: it can be applied to both individuals and groups. An individual has his or her own livelihood system, but also groups can have livelihood systems, and the size of the group can range from small to very large. One livelihood system can be entirely different from another. Some systems are fairly simple and relatively easy to describe, like that of a single-crop farmer (although one could go into complex details like the cell biology of his crop), whereas others are much more complex. An example of the latter is the livelihood system of tobacco growers in certain areas, who employ seasonal workers, finance their crops with borrowed money, and sell their crops on the international market.

Figure 2. Sustainable livelihoods framework



source: DFIS, 1999

In recent years, the concept of 'sustainable livelihoods' has become a central feature of development discourse. This approach is premised on the idea that

communities derive their livelihoods from different types of 'capital' (see Figure 2 and Figure 3). In this context, 'sustainability' is defined as the maintenance of stocks or capital over time, and a sustainable society is one that is able to nurture and enhance these stocks (Warren *et al*., 2001). Although there are a number of different adaptations of the sustainable livelihoods model, the main concept remains the same. Following the definitions provided by Scoones (1998:7-8), five main types of capital are commonly identified (Fig. 3).

Figure 3. Sustainable livelihoods – types of capital

- **Natural capital** – the natural resource stocks (soil, water, air, vegetation) which are essential for sustaining livelihoods.

- **Economic or financial capital** – the capital base (cash, credit, savings, remittances and economic assets), which allows individuals and households to make livelihood decisions about investments in natural, human or other forms of assets.

- **Human capital** – the skills, knowledge, ability to provide labour and good health, and physical capability which allows individuals and households to successfully pursue different livelihood strategies.

- **Physical capital** – the basic infrastructure, manufactured goods and tools which are required to produce or pursue livelihood strategies.

- **Social capital** – the social resources and relations (networks, social claims, relationships of trust, affiliations, associations) upon which people draw when pursuing different livelihood strategies that demand coordinated actions.

Adapted from Scoones (1998)

At any specific moment in time, individuals or groups may possess different combinations of capital in their livelihood 'portfolios.' Indeed, if a group is lacking in one category of assets, capital might be converted from one form into another (Stocking and Murnaghan, 2001), but ultimately, changes in the level of available assets may affect the ability to engage in sustainable practices. Livelihood portfolios are therefore dynamic, and livelihood strategies are susceptible to change over time and space, as local and external conditions change. Thus, according to Chambers and Conway (1992):

> A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base (cited in Scoones, 1998: 5).

Scoones (1998) adds that within the sustainable livelihoods framework, there are three broad 'clusters' of livelihood strategies: agricultural intensification/extensification, livelihood diversification and migration. He notes, "Either you can gain more of your livelihood from agriculture…through processes of intensification (more output per unit area through capital investment or increases in labour inputs) or extensification (more land under cultivation), or you diversify to a range of off-farm income earning activities, or you move away and seek a livelihood, either temporarily or permanently, elsewhere" (1998: 9). More commonly, individuals may pursue a combination of strategies in their livelihood portfolios. In improving and safeguarding their livelihood base, individuals, households, or groups do not merely rely on agriculture alone, but rather they draw on a wide range of other resources, including non-farm activities and migration.

The MA conceives of livelihoods as a nested component of human well-being, without further defining it. People require both material and immaterial inputs to enhance their well-being. Building on Scoones' (1998) definitions of capital, according to the MA, there are five main types of capital: natural resources, infrastructure, finances, social capital, and human capital (Neefjes, 2000). The latter includes skills, labor, and knowledge. Although the MA proposes the addition of a sixth category – political capital – most other livelihood frameworks include this as a component of social capital. Social capital is described as the social contacts and networks that people maintain. Individuals make use of these different types of capital, some of which they may possess adequate amounts and others of which they may lack, to pursue well-being. They design livelihood strategies, in which the different forms of capital play an important role and are constantly substituted for one another. This happens, for instance, when financial capital is used to acquire infrastructural capital, such as a tool or machine, which can be used to exploit a natural resource, after which the products of such efforts are turned into financial capital once again.

Also clear from this example is the idea that capitals flow. The dynamic nature of capital is important because if capital remains idle, it adds nothing to human well-being; livelihoods cannot be created from capital that remains an endowment, a promise or a potential.The livelihood concept is therefore not a static concept, but rather a highly dynamic one that remains important to our approach for dynamic socioenvironmental systems.

For capitals to flow, individuals must be able to mediate their claims to each type of capital. For example, a person claiming expertise in a certain field must meditate this claim (e.g. by showing a certificate or diploma). A person who wants to produce crops on a field must prove his or her right of access to that land. Of key importance for claiming rights are local, national, and even international institutions, including markets, systems of governance and policies in a country. In short, "All these things – the government structures, policies, laws, markets, cultural practices and institutions – are important in defining rights

and responsibilities, and also in defining the terms on which different capitals can be used and (re)generated, and be substituted for others" (Neefjes, 2000)

According to the MA, the concept of sustainable livelihoods is defined by the following conditions:

- A livelihood is sustainable if it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets now and in the future;
- a livelihood is sustainable in a social context when it enhances or does not diminish the livelihoods of others; and
- a livelihood is sustainable when it does not deplete or disrupt ecosystems at the expense of the livelihoods and well-being of others, now and in the future.

2.3. Livelihoods in dynamic socioenvironmental systems

For the purpose of this paper, our definition of the concept of a livelihood system is as follows:

A system operated by a person or individuals, linked together because of their shared aim to acquire, in a specific ecosystem, constituents for individual well-being.

This definition links the concept of livelihoods to a specific ecosystem, which remains essential to our understanding of dynamic socioenvironmental systems. We use the concept to analyze dynamic socioenvironmental systems, and in particular, the dynamics that result from the actions of people in that particular environment. It is noteworthy that the definition refers to '*individuals* linked together because of the shared aim…to acquire…constituents of well being', and the word *group* or *organization* is not used. This choice of words was made because a *group*, and certainly an *organization*, suggests formal links between the members and a common interest. With respect to livelihood systems, this is not necessarily the case. Individuals in a livelihood system are only linked together because they are related in one way or another to a set of constituents from a specific ecosystem. They may play different roles, however. Some may be producers of the constituents, others trade in them or finance their substitution in another type of capital, and there may be other people still that consume the constituents.

Essential to our definition of livelihood systems is that the consumers of a constituent are also an influence on a livelihood system. In today's globalizing world, the consumers of natural capital goods acquired in a specific ecosystem can be living in other ecosystems, which are often located at great distances from where those goods were obtained. As De Haan (1999: 15) has noted, when

studying livelihood systems, it remains essential to consider local arenas in wider perspective by considering 'how the adaptive capabilities of actors are influenced, restricted or stimulated by integration in larger social-cultural, economic and political-cultural entities…'. In this respect, livelihood strategies may not only be 'multiple' but may also be 'multi-local' (De Haan, 2000). A livelihood analysis can thus foster the study of macro–meso–micro linkages, which is useful in understanding how actions at greater scales affect the livelihood options of poor individuals and communities, and how poor actors in turn affect policies and institutions (Buechler, 2004).

For example, let us consider the case of rattan – a species of palm similar to bamboo that is obtained in the forests of Southeast Asia, Australasia and Africa, and is used to make furniture and baskets which are predominantly bought by consumers in western countries. The acquisition of rattan, as is the case with any natural capital good acquired in any ecosystem, has an effect on the ecosystem from which it is obtained. This consequently, has an impact on the ecosystem services and the ultimate sustainability of the ecosystem. Moreover, it also has an effect on the social sustainability of the many other livelihood systems that also rely on that ecosystem. In forests where rattan grows, its economic value may actually help to protect forest cover, by offering an alternative livelihood to loggers who choose to forgo cutting down trees in favour of harvesting rattan cane. Rattan is easier to harvest (less human capital needed), requires simpler tools and is easier to transport (less physical capital). Thus consumer demand for rattan in western countries can be seen to shape livelihood decisions in ecosystems at great distances away.

The livelihoods concept thus offers the possibility of linking consumers anywhere in the world with important ecosystem and social sustainability questions. In a globalizing era where the local is inextricably linked to the global – a concept that some now refer to as 'glocalization' (Robertson, 1995) – we further believe that people are responsible for their actions and their ensuing consequences, whether they are derived directly or indirectly. The livelihoods concept can be an important tool for understanding these effects. The responsibility of securing both ecosystem and social sustainability should not only come from the producers of natural capital goods and from local authorities, but should also be supported by national authorities and laws and regulations. This argument has been rehearsed elsewhere, but we support this general conclusion that better social and environmental outcomes are possible for producers, if consumers are more responsible in their choices. An optimistic point of view would suggest that present-day consumer concerns for transparency and ecological sustainability, in concert with modern communication technology, should make it more possible than ever before for consumers to be more responsible, and only accept products that are ecologically and socially sustainable.

In a related vein, we believe that it is all too easy to blame local authorities for failing to make responsible choices which lead to negative impacts on ecosystem

and social sustainability, even in situations where rules and regulations are essentially supporting sustainability. Although consumers should take responsibility for their actions, in addition to the concepts of ecosystem and social sustainability, it is important to recognize the notion of institutional sustainability. In this light, consumers should only accept services from responsible authorities that are in accordance with the rules for good stewardship in general, and with existing rules and regulations on ecosystem and social sustainability in particular. Governments of countries importing services, as well as consumer organizations, should develop rules for importing ecologically sustainable, socially sustainable, and institutionally sustainable products acquired in overseas ecosystems. In this respect, the initiative of the Round Table on Sustainable Palm Oil serves as a positive example. A range of players, all involved in the livelihood system to acquire, process, transport, finance and produce oil palm products, has combined forces to set up rules for sustainability at different fronts. The players include representatives from: oil palm growers, palm oil processors and/or traders, consumer goods manufacturers, retailers, banks and investors, environmental/nature conservation NGOs, and social/developmental NGOs. However, it would appear that there are still a number of important representatives lacking, including the governments of both producing and consuming countries and the consumers of the end products.

A final important observation is that people do not necessarily belong to only one livelihood system and that they may acquire constituents for their individual well-being from more than one ecosystem. Moreover, the evolution of transport and communication systems over several centuries, has made it possible for individuals the world over to live in a ‘detached’ state from the ecosystems on which they depend. Indeed, the conclusion must be that we all participate in different livelihood systems.

3. Lessons from practice

3.1 Analyzing livelihood systems

Capitals – natural resources, infrastructure, financial capital, social capital and human capital – are at the core of the livelihood system concept. When describing the actions of the relevant livelihood systems in a given ecosystem, especially in relation to that ecosystem and to other livelihood systems, the various types of capital and how they are substituted by each of the relevant livelihood systems obviously plays an important role. Core questions are:

- What combinations of capital are available to the people of a certain livelihood system?
- What are the strategies of the persons of a livelihood system to achieve their aim to acquire a certain set of constituents in a certain ecosystem?
- What right of access do people of a certain livelihood system have to which capitals? Or in other words, how do people mediate their claims and are they effective in doing so?
- What do the actions by the people of a livelihood system to acquire constituents mean for the efforts of the people of other livelihood systems to acquire the same constituents? Or in other words, how socially sustainable are the livelihood systems?
- What do the actions by the people of a livelihood system to acquire constituents in an ecosystem mean for the sustainability of that ecosystem?
- And finally, what is the institutional environment – government structures, policies, laws, markets, cultural practices and institutions – in which the strategies for livelihood development are carried out?

This last question is especially relevant because of the ultimate purpose of the present paper – that is to contribute to the preparation of Guidelines on agriculture-wetlands management for the people responsible for the government structures, policies, laws, markets, cultural practices and institutions. The combined answers to the other questions provide a picture of the dynamics of a specific socioenvironmental system. In the subsequent sections, three selected dynamic socioenvironmental systems will be described using the concepts that have been introduced above. We describe each socioenvironmental system to demonstrate the value of the notion of livelihoods and its related concepts, as a tool to give a broad picture of what is happening in real world situations. In the process of this discussion, it is not our intention to make value judgments that concern what is going on, or to suggest solutions of any kind.

3.2 Kolleru Lake, Andhra Pradesh

3.2.1. Introduction

Kolleru Lake forms a part of the deltaic wetland system formed by Krishna and Godavari, the two longest rivers in southern India. The lake is a cusp-like formation between the Godavari and Krishna Deltas in its north and south respectively, with two parallel formations of Eastern Ghats in the northwest and a series of moderately high sandy beach ridges in the southeast. It receives inflows from four rivers – the Tamilleru, Budumeru, Gunderu and Ramilleru – and a dense network of 30 channels, and drains emanating from the irrigation projects on Krishna and Godavari Rivers. The shallow-basined wetland extends to 900 sq km during peak monsoon flows and shrinks to 53 sq km during summer (Figure 4). The lake levels fluctuate between + 3 feet amsl during summers and +10.5 feet amsl during peak monsoon.

Figure 4: Location of Kolleru Lake

Kolleru lake basin extends to an overall area of 8,923 sq km. Its land use is dominated by agriculture, which accounts for 68% of the total area. Kolleru Lake

is an aquaculture hub of region, with 55% of its area being dominated by fish farms. There is very limited perennial vegetative cover within the basin and only patches of degraded forests are located at the crest of the basin. The region has a semi-arid climate and receives rainfall from the southwest as well as northeast monsoon. The average rainfall is 1,000 mm within Kolleru Lake area, which increases to 1,300 mm within the Eastern Ghats. Failure or delayed monsoon rains can lead to drought-like situations in the uplands. Depressions in the Bay of Bengal are common and are generally experienced between August – November.

Ecosystem services provided by Kolleru Lake play a very significant role in ensuring ecosystem and livelihood security within the region. Located between two quaternary deltas, the lake attenuates floods and thereby forms the basis of development of large economic infrastructure within the region. In the past, it was an important source of freshwater in the coastal region, and was the backbone of agriculture. Its natural connectivity with the sea ensured rich fisheries with both freshwater and brackish water species. Abundant food availability and rich habitat supported rich biodiversity within the entire region. Kolleru was known as Asia's largest pelicanry for spot billed pelicans. The lake was traditionally managed for agriculture and capture fisheries. Based on its rich biodiversity, particularly avian diversity, an area of 308 sq km within the lake, lying broadly within the + 5 feet amsl elevation, was demarcated as Kolleru Wildlife Sanctuary by the Government of Andhra Pradesh in 1996. The lake was identified as a priority for intensive conservation and management under the National Wetland Programme of the Government of India and was also designated as a Ramsar Site in 2002.

Lop-sided developmental planning aimed at agriculture and aquaculture development for short-term economic gains without considering the ecosystem services naturally provided by the wetland, has led to its rapid degradation. Changes in land-use pattern within the basin, and construction of hydraulic structures to divert water for agriculture development, have led to fragmentation of the entire wetland regime and limited its connectivity with the coastal system. Consequently, the flood attenuating capacity of the wetland has been greatly reduced due to degradation of the catchments and construction of flow impeding and sedimentation enhancing structures such as aquaculture ponds, roads and channels within the wetland area. Rapid increase in economic activity, particularly aquaculture development, has also induced the migration of people into the wetland area, thereby considerably enhancing anthropogenic pressures on the wetland resources. Changes in wetland regimes have also impacted the overall biodiversity, particularly of fish and avian fauna. The shifting livelihood systems have led to a complete breakdown of the traditional wise use management systems and have given way to narrowly focused market driven systems with high vulnerability and limited coping capacities.

The analysis of the dynamics of livelihood systems operational within Kolleru Lake presents important lessons for understanding the agriculture-wetland interactions and their sustainable management. The following sections present a description of the prevailing livelihood systems within Kolleru Lake, their dynamics and social and environmental sustainability, and the key lessons for managing wetlands-agriculture inter-relationships.

3.2.2 Capitals available to the prevailing livelihood systems

The wetland is densely inhabited and presently supports a population of 0.34 million people living within 96 villages. Livelihood systems are distinctly different within the lake area, both within and outside Kolleru sanctuary. Livelihood systems within the sanctuary area are based on a combination of aquaculture labour, single-cropped agriculture and capture fisheries. Within the area outside the sanctuary, livelihood systems are based on irrigated, double-cropped agriculture and highly intensive aquaculture.

There are 16,400 households living within Kolleru sanctuary area. The population mainly comprises Vaddis and Dalits, whose livelihoods have been traditionally associated with the lake resources. Labour employment within fish tanks provided employment to 42% of the workforce in these communities, until there was a complete banning of aquaculture within sanctuary area in 2005[4]. Presently, there is a high level of migration within these communities. Income is augmented through engagement in capture fisheries, agriculture and trade. Due to fluctuating lake levels, agriculture is limited only to a single crop. Rights to productive assets such as aquaculture farms are principally vested within the population living outside the sanctuary. The region has good road connectivity and access to electricity, primarily to support trade in fish. However, access to safe drinking water and sanitation is limited.

Livelihood systems in the lake area outside sanctuary can be broadly termed as an entrepreneur – trader system based on highly intensive aquaculture and agriculture. As per the land-use estimates, 55% of the lake area outside sanctuary is under aquaculture, followed by 45% under agriculture. The intensity of aquaculture has increased from 6 – 7 ton/ ha in the 1980s to 10 ton / ha at present. The region has access to a well developed irrigation system supported by two major barrages on the Krishna and Godavari Rivers, and therefore supports double-cropping agriculture. Ownership of the assets is vested within these communities, apart from a small population of Dalits whose livelihoods depend on migrant labour within the agricultural fields and aquaculture ponds. There is a strong level of organization within the aquaculture farmers, who have

[4] The Supreme Court of India, the apex judiciary, declared aquaculture within Kolleru Sanctuary as an illegal activity through a ruling in December 2005. The Government of Andhra Pradesh thereafter undertook drive to demolish all aquaculture farms within the sanctuary area. However the activity continues outside the boundary of the sanctuary area.

formed political lobbies, and have a major say in developmental activities within the lake area.

In the context of the present framework, it is useful to highlight that the two livelihood systems share common constituents, particularly the natural capital based on various ecosystem services drawn from Kolleru Lake, within which the two livelihood systems operate. However, differences in access to economic and financial capital, human capital and physical capital lead to a virtual domination of the traditional livelihood system by the entrepreneur – trader system operating outside the Kolleru sanctuary. The structure of rights and capabilities almost define a relationship of subservience between the traditional livelihood system and the entrepreneur – trader system, with the latter having a high degree of influence on the livelihood options and dynamics of the former.

3.2.3 Dynamics of the livelihood systems

Livelihood systems within Kolleru communities have been changing with the shifts in development priorities and resource-use patterns. Economic incentives based on the development of newer income generation opportunities have played an important role in the transition of livelihoods from traditional wise use to intensive agriculture, and subsequently, aquaculture dominated systems. These have also led to concomitant changes in institutional structures, rights of access and coping mechanisms of the communities.

The deltaic region of Krishna and Godavari were marked with frequent occurrence of catastrophes, such as floods and droughts. Livelihoods of limited population within this region were traditionally based on rainfed agriculture (paddy crop of native variety) and capture fisheries. Native wild varieties of paddy rice, naturally available within the lake, were harvested for local consumption. Inundation of the deltaic region in the monsoon seasons led to high recruitment of fish, which, with the declining water levels, were automatically concentrated within the lake. In the lean season, the exposed areas of lake were cultivated by lifting lake water through the use of mechanical contrivances. The subsistence nature of this farming system made the erstwhile rulers forego the imposition of any form of taxes on these lands.

The British established their rule in the region early in the 19th century and were faced with a ravaged countryside. In 1832, nearly two fifths of the Krishna delta population was wiped out due to failure of the monsoon, upon which the rainfed paddy depended. The tremendous challenge posed by the immense loss of lives and property, as well as a declining revenue base, forced the British engineers to plan irrigation schemes throughout the entirety of the Krishna and Godavari Basin. Of the several projects, the most significant in the region were development of weirs on Godavari and Krishna Rivers at the heads of two deltas during 1857 – 1862. The two projects made it possible to harness the river

waters for irrigation within the Kolleru Basin region. Agriculture within Kolleru Lake area received a further boost through an increase in the height of Krishna weir in 1903. The weir, damaged by a flood in 1952, was immediately replaced by the Prakasam Barrage, a slightly taller structure built a few meters upstream. The two structures on the rivers ensured irrigation for rabi as well as kharif crops[5] in the entire region, and led to the extension of agriculture to +5 feet amsl within the Kolleru Lake area.

However, agriculture within the sanctuary area remained limited. Fragments of lake bed within the sanctuary were brought under agriculture by some owners of oil engines called the *"enginedaars",* who used to take government land within Kolleru on lease. These areas of the lake bed were made cultivable by the construction of earthen embankments and bailing out water using the engines. The owners used to then sublet the lands to the cultivators and provide credit at exorbitant interest rates, for the purchase of farming inputs as well as for bailing out water. Thus, of the total produce, three fourths used to accrue to the landlords. The government reviewed the system and initiated cooperative farming, restricting the sharing of the produce between the lease grantee and the cultivator to 40:60. The farmers subsequently organized into societies enabling them to directly lease the land through the government. Concurrently, the government also introduced hybrid variety of seeds, fertilizers and pesticides, enabling an increase in productivity and household incomes. This led to nearly a double increase in productivity. By 1968 - 69, the entire lake area was brought into agriculture.

With the development of an ensured water supply for agriculture, the fluctuations in lake levels, particularly those beyond +5 feet amsl, became a potential threat to productivity. Interventions were therefore now directed at keeping the lake levels lower through regulating the inflows as well as enhancing the outflows. Massive bunds were constructed along Godavari and Krishna Rivers to prevent flood damages. As a response to the extensive and recurrent damages to agriculture crops, the government undertook several measures to control the hydrological regimes. Construction of flood-moderating reservoirs on the rivers Tamilleru and Yerracalva, and diversion structures on Budumeru, was undertaken to attenuate monsoon inflows. The operation of these structures reduced the overall inflows into the wetland by 74%. Additionally, channelization schemes were undertaken within the lake area to reduce the inundation of agricultural fields within the lake bed. Measures were also undertaken to enhance outflows through the widening and deepening of Upputeru. Locks were constructed to prevent salinity intrusion in agricultural lands within the coastal areas. This enabled a shift in livelihoods to intensive agriculture that was characterized by an abandonment of the native crop varieties, the introduction of shorter, high-yielding, fertilizer-consuming and water intensive crops, making agriculture an economic preposition from a mere sustenance option. Capture

[5] Rabi and kharif refer to winter and summer crop respectively.

fisheries remained a secondary option, and fishing was practiced with traditional bamboo made crafts and gears.

However, as these activities to support agriculture were being undertaken, the entire region was affected by a devastating cyclone in 1969, leading to tremendous loss of lives and property and a near complete salinization of lands in and around Kolleru. Agricultural productivity reached dismal levels during 1969 – 74, leading to very high levels of migration amongst the people from the Kolleru area. During the same period, several important developments took place; notably the development of a new avenue of fish marketing through export to Kolkata. The construction of a new railway bridge across Prakasam Barrage also brought new regional connectivity to the Kolleru region.

In an attempt to alleviate poverty within the Kolleru communities, the government introduced aquaculture in the lake area, under a World Bank assisted Inland Fisheries Project (IFP). This project was designed to utilize the fallow uncultivable and less productive land for pisciculture. The new livelihood system introduced a nearly risk free enhancement in the incomes of marginalized communities. In the semi intensive mode, an income of Rs.30,000 per acre[6] was reported with an investment of only Rs.10,000 in an acre. This marked the third distinct shift in livelihood systems.

The vulnerability of the owners of the fish ponds, with limited capacity even to purchase the inputs, induced the introduction of private entrepreneurs into aquaculture. By 1984, about 2025 ha of government land in the Kolleru Lake was converted into fish ponds under the management of Fishermen Cooperative Societies. Entrepreneurs with socio-political status, stated to be mostly belonging to the upper strata of society, rapidly entered into fray, increasing the intensity and scale of operations within the lake. The original owners were reduced to laborers within these ponds, and were given a small share in the form of land lease, which had to be shared through a series of commission agents and money lenders. Kolleru Lake emerged as the ‘Freshwater Aquaculture Hub’ of the country where more than 77,500 ha of aquaculture areas were developed up to + 10 feet amsl. By this time, the Supreme Court ordered the demolition of the fish ponds within the Kolleru Sanctuary area, and fish farms extended to 55% (180.34 sq km) of the sanctuary area. Of this, 44% of farms had an area more than 30 ha, with ownership of 76 beneficiaries. The rest was under 1570 tanks with an average area of 6 ha, owned by 1200 beneficiaries.

Technology and productivity of freshwater aquaculture within Kolleru underwent a massive shift, with an increase in aquaculture area and profitability as compared to alternate livelihood options. The technology adopted during the initial phase was based on the composite fish culture involving Indian Major Carps and exotic carps. However, in the later part of the 1980s, when farmers realized that increased biomass production from aquaculture with multiple

[6] The acre is an area measurement unit, 2.47 acres equal 1 hectare.

species did not lead to commensurate increase in profitability, they eliminated all species which had no high market / consumer demand (exotic carps) and focused largely on single species (i.e. rohu (*Labeo rohita)*). The productivity increased tremendously from less than 4 t / ha during 1976 – 80 to 10 t / ha in 1996 – 2000.

Increased economic activity promoted investment into transport infrastructure. Thus 46 roads with a total length of 140 km were constructed within the lake area to facilitate transport of fish. The dependence of Kolleru communities on wage incomes increased to very high levels, and the natural instinct of a diversified livelihood pattern with a system of inbuilt coping mechanisms was completely lost. When the aquaculture was banned within the sanctuary area, the communities were devastated and loathed getting back to the past occupational practices.

The rest of the lake area, particularly the region beyond the sanctuary, was gradually exploited for double-cropped agriculture as well as fish farming. The region was relatively less vulnerable to devastating floods, and furthermore was able to benefit through upstream diversion structures. Rich farmers, with lands located at the heads of irrigation projects, gradually shifted to economically more profitable crops such as sugarcane. The growth of agriculture and major road transport networks, with excellent communication infrastructure, was attributed to the overall prosperity within the region. In the catchments, particularly those beyond Ellore canal area, agriculture was primarily based on irrigation through community tank systems. With a gradual erosion of the infrastructure, there was diversification to horticultural crops, particularly mangoes and banana.

An assessment of the dynamics of the livelihood systems indicates that within the Kolleru Lake system, multiple actors have been engaged in seeking livelihoods based on the wetland services, but often with conflicting interests. Given the combination of capitals available to the traditional livelihood system, the strategy was focused on seeking a balance between the various provisioning, regulating, cultural and supporting services. The objective of the entrepreneur – trader system, which dominates the livelihood systems within the Kolleru Lake, however, is more focused on profit maximization. However, it has been achieved through an augmentation of the provisioning services at the cost of other services of the wetland, and has thereby made the entire livelihood system unsustainable.

3.2.4 Social sustainability of the livelihood systems

The sustainable management of Kolleru is inextricably linked with the social and environmental sustainability of the livelihood systems operating within, as well as those dependant on, the lake ecosystem. However, the changes in livelihood systems have altered this critical inter-relationship, thereby leading to the degradation of the livelihood asset base, as well as the overall well-being of the

communities. In particular, the traditional livelihood system of the Vaddis and Dalits living within the Kolleru sanctuary has been affected, as is evident by the following:

- ***Loss of livelihood diversification and coping mechanisms:*** In the traditional system, economic activities were diversified and were based on wise use of Kolleru lake resources, which were harmonized with a balance between its various ecosystem services. However, in the subsequent periods, livelihoods transformed, first of all to intensive agriculture, and in later periods to aquaculture. The traditional diversity of livelihoods was thus gradually lost, rendering the communities vulnerable to shocks. Over the last fifty years, this has happened twice, first with complete devastation of agriculture, and second with commercial aquaculture. Gradually, the coping mechanisms have also dwindled, forcing people to migrate.
- ***Changing internal community relationships:*** The erstwhile homogeneous community with governance based on customary laws, has been gradually fragmented with changes in the economy. The lake communities have been traditionally governed by caste panchayats[7], locally called Kula Panchayats. The members of the Kula Panchayat are reported to have used their influential position to cartelize their control over community assets and amass wealth through the appropriation of village common funds and assets. The system of auctioning of the fishing enclosures within the lake and fish ponds do not have adequate transparency to allow equitable sharing of the returns by the entire community. A low degree of collectivization limits their share in economic enterprise and curtails their rights and security of tenure. Thus, despite a very high level of economic growth within the Kolleru Lake based on development of agriculture and aquaculture, the communities are content with wage earnings, without getting a share at higher levels of the market chain.
- ***Iniquitous sharing of economic benefits:*** In the traditional livelihoods systems, though the productivity was low, the economic returns were accrued largely to the communities directly. With proliferation of agriculture, the system of sharing agricultural produce was introduced, which to a large extent was in the favour of the cultivator. However, with aquaculture, the situation has been entirely different. Despite forming nearly 70% of the overall population working within the sector, only 10% is accrued to the communities, the rest being shared within the outsider operators and those engaged in ancillary services. In real economic terms, while the outside operators have reaped immense economic benefits, the communities had to be content with

[7] A caste is a hereditary social stratification system prevalent in India. A caste panchayat is the primary community governance institution within several villages of India, including the Kolleru villages . The Kula Panchayat is governed by Pedda Vaddi, comparable to a Sarpanch (Headman), assisted by a maximum 7 Peddalu (Members), depending upon the population. The Kula Panchayat governs all the community activities in private as well as social decisions, including marriages, elections of Sarpanch, Samithi President, membership to political bodies, nomination of contractors, etc. Violation of orders of Kula Panchayat invokes a fine or in extreme cases, ex communication.

only marginal increases in annual incomes, with a tremendous loss of livelihood resilience.

3.2.5 Environmental sustainability of the livelihood systems

Well-being of the communities living within the Kolleru Lake is dependant on the maintenance of the natural capital (i.e. the various ecosystem services derived from the wetland system). However, changes in livelihood systems have been achieved through a gradual diminution of the regulating (maintenance of hydrological regimes and biodiversity) and the supporting services of the wetland to achieve a higher level of provisioning services (more fish and crops) to environmentally unsustainable levels.

The entire wetland system located within the Krishna – Godavari deltaic system constitutes a single ecological unit. The fluctuating water regimes of the lake ensured connectivity between the coastal systems as well as inland freshwater systems. However, with the advent of intensive agriculture and aquaculture supported by irrigation systems, the fluctuating lake regimes posed a great threat to the high levels of economic activity within the lake system. Modification of hydrological regimes to support freshwater-dependant livelihood systems – firstly agriculture and subsequently aquaculture – has led to the fragmentation of the entire wetland regime, particularly the coastal systems. Presently, the Upputeru remains the only connectivity of the lake to the sea, and is under tremendous pressure for being regulated through the construction of a hydraulic structure. The construction of a network of roads and bridges and aquaculture farm dykes has led to the compartmentalization of the wetland system. The loss of water holding capacity due to catchment degradation, construction of aquaculture ponds and road networks, has impeded the natural flow patterns and promoted extensive waterlogging. This has had adverse affects on agricultural crop productivity as well as flooding settlement areas.

The interconnectivity between freshwater and marine systems ensured rich biodiversity within the entire Kolleru Lake Basin. However, the current livelihood systems are dependant on few species leading to a rapid decline in overall biodiversity, as is evident through declining populations of Gray Pelican, which has almost disappeared since 1973. Kolleru was once India's most significant pelicanry, and important breeding colonies of this species were found in the lake area. Changes in hydrological regimes have also led to the prolific growth of invasive species (*Eichhornia crassipes, Salvinia ariculata* etc.), impacting native species and overall biodiversity. The introduced exotic species Java tilapia has grown profusely, leading to a loss of native fish species.

Intensive agriculture and aquaculture are dependant on the heavy use of chemical fertilizers and pesticides, a major portion of which is deposited in Kolleru as runoff. The lake also receives untreated sewage from the highly

populated settlements located both within and on its periphery. Needless to say, these contribute to the contamination of the lake and the deterioration of its water quality.

Emphasis on water allocation for human purposes that ignores ecological requirements is a critical issue that needs to be addressed for environmental sustainability. Since 1968-69, the traditional rainfed crop varieties have been replaced by high-yielding but water intensive seed varieties. With the introduction of irrigation systems, perennial crops such as sugarcane have been introduced at the head reaches of the canal system. As perennial crops such as sugarcane induce lesser water stagnation and higher evapotranspiration, there is a reduction in the downstream availability, where the wetland is located. The situation is more severe in the peak summer seasons, when the irrigation demands are at a maximum, and the natural flow to the wetland is at abysmal levels.

3.2.6 Institutional environment

The current institutional environment influencing the planning and development processes within the region is an array of decision-making and planning entities, often working for cross purposes with a marked absence of an integrated framework for the conservation and management of Kolleru Lake. Decision-making for lake management is primarily done through the democratically elected state representatives. However, decision-making is biased, based on representation in various sociopolitical contexts and lobbying, and the views of the wetland communities are often marginalized in the process. Economic and revenue perspectives serve to be weightier than environmental issues, and therefore the aquaculture farm owners and large agriculture farmers are able to influence the decision-making process.

At the state government levels, there are several agencies involved in lake management, but without an integrated framework, and therefore often work for cross purposes. Prior to 1982, the main focus of developmental planning within Kolleru Lake was on agricultural development and therefore the Revenue Department served as the nodal agency. Gradually, with increased realization of environmental concerns, several state government departments / agencies were involved in addressing the environment issues of the lake area. Thus the state government departments of Environment, Science and Technology, Pollution Control Board, concerned university departments, NGOs, community-based organizations, CBOs and other concerned agencies, were involved in the management of Kolleru Lake. All these agencies, however, lack coordination and almost work independently of one another. At present, the State Department of Wildlife Protection is the nodal agency responsible for the conservation and management of the Kolleru Lake. The broader mandate to the organization is again focused on wildlife conservation, with very limited focus on sustaining livelihoods.

An assessment of the institutional environment indicates its failure to effectively mediate the conflicting interests of the communities deriving livelihoods from the Kolleru Lake. This has led to the marginalization of traditional livelihood systems and environmental and social unsustainability. There is a marked absence of an integrated vision for wetland management based on sustaining the linkages between the ecosystem services, livelihood systems and human well-being. However, with the Supreme Court judgement indicting intensive aquaculture and agriculture development within Kolleru Sanctuary as a potential threat to the overall values and functions of the sanctuary area, and subsequent orders for its complete regulation, the state government has been forced to look again into its overall development priorities. Ultimately, this has led to the drafting of a management action plan harmonizing human needs with the ecosystem services for the overall human well-being.

3.3. Valley Head Wetlands of the Illubabor Highlands, South-West Ethiopia

3.3.1. Introduction

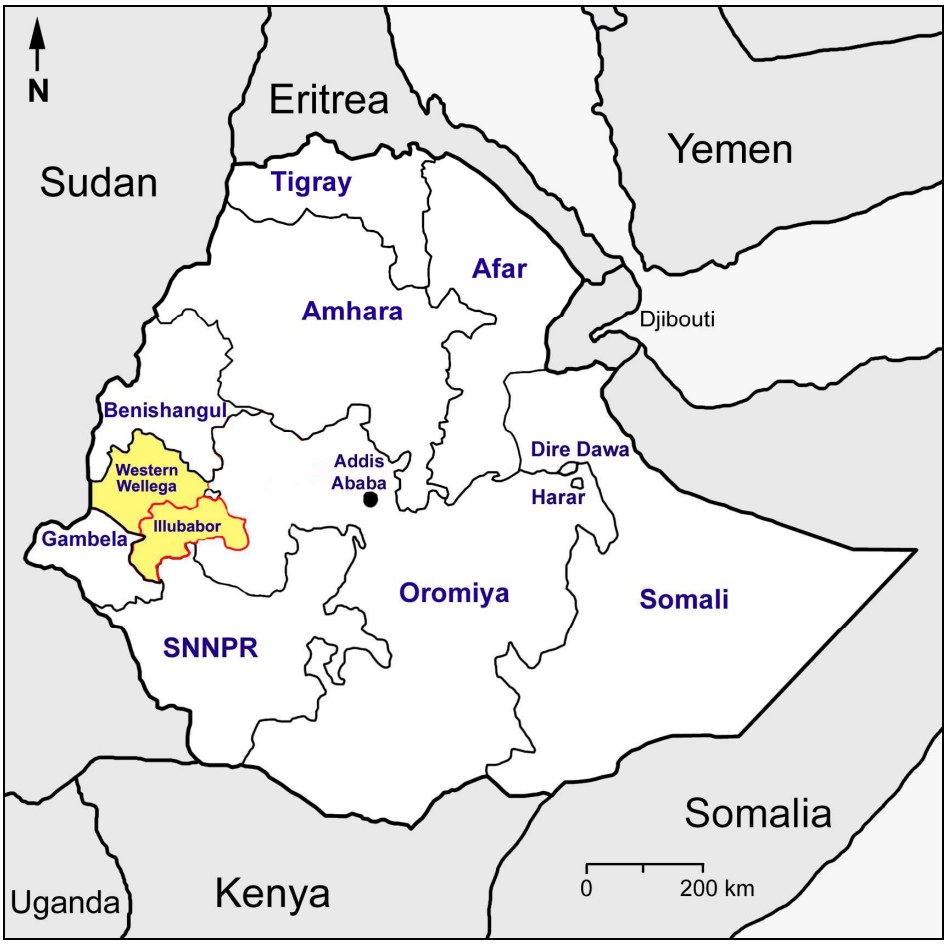
The predominantly small (5 ha – 50 ha) valley head or upper valley wetlands of the Illubabor highlands in south-west Ethiopia have long been important multiple-use livelihood resources that have performed a wide variety of ecological, hydrological and socio-economic functions (see Figure 5). Most commonly, the tropical montane forested highlands of the region are characterized by blocked valleys and permanent wetlands, with *Cyperus latifolius* sedges being the dominant vegetation type. While these sedges (known locally as *Cheffe*) have been vital resources for the thatching of local houses, rural populations have also relied on wetlands for water collection, medicinal plants, craft materials and clay for making pots (Dixon and Wood, 2003). Perhaps most importantly, however, and of great relevance to our GAWI discussion, wetland agriculture in the region has been vital for the survival of local populations, particularly when food shortages occur between June and September before the main harvest in October.

Valley core records indicate that there is a very long history of wetland use in this region. Evidence from carbon dating suggests that wetlands have been utilized by local people for almost 1000 years, and historical records show evidence of at least 200 years of wetland use (Wood *et al.,* 2005). Since the 17th and 18th centuries, there has been a history of population expansion into the forested south-west regions of Ethiopia, particularly by the Oromo people. Additional immigrants from other parts of the country arrived during the latter half of the 19th century as part of the incorporation of the region into the Ethiopian state, but the associated warfare led to a population collapse in the area. Since these early

days, the importance of wetland use has waxed and waned as population pressure has fluctuated over time.

However, in last 50 years in particular, the expansion of wetland cultivation has been stimulated by a variety of new factors. Prior to 1974, a historically-evolved feudal landlord system regulated resource management and property rights in the Illubabor Zone. At first, landlords saw increased wetland use as a way of boosting peasant food production and hence their income from share-cropping (Bekema *et al*., in press). However, after the revolution in 1974, the new military government, popularly known as the *Derg*, dissolved this tenure system, the landlords were disposed of, and in 1975, one of the most ambitious land reform programmes in Africa took place. After 1975, there was a major increase in wetland use in the post land reform period, which gave more people access to wetlands as landlord's land was redistributed within the community to try to achieve equity. As new market opportunities developed, livelihood systems evolved and coffee cultivation on the interfluves displaced some cereal cultivation into wetland areas. By the mid-1980s, government policies further promoted wetland food production as a response to food insecurity. Consequently, by the 1990s, estimates suggest that between 12% and 23% of wetlands in the Illubabor area were under cultivation (Afework Hailu *et al*., 2000). Although in many cases, such cultivation only involved partial wetland drainage and planting, in other cases, this entailed the total draining of wetlands. In the latter case, this seems to have benefited a small number of the more resource rich farmers, whilst disrupting a number of livelihood benefits which many other people obtained from the wetlands (Wood, 1996; 2001).

Figure 5: Location of Illubabor Zone in South-West Ethiopia



3.3.2. Capitals available in the prevailing livelihood systems

As was noted in our discussion of livelihood systems in section 2.2, the concept of 'sustainable livelihoods' is premised on the idea that households and communities derive their livelihoods from different combinations of capital. At any specific scale and point in time, an individual's livelihood portfolio will comprise different capital endowments, encompassing a diverse range of activities (Scoones, 1998). The tendency to diversify livelihood portfolios in Illubabor is widespread, where actors pursue complex and dynamic livelihood strategies that involve the intertwining of various activities. Indeed, the now burgeoning literature on livelihood diversification identifies a wide range of factors that help to explain why diversification occurs and how patterns of diversification are shaped (see Ellis (1998) for a good review of the literature).

In this section of the paper, our attention shifts to a discussion of the various capital assets that are available to prevailing livelihood systems in Illubabor, and

particularly those that are derived from wetlands. For the reasons noted above, however, it is not possible to describe specific livelihood systems *per se*, because of their dynamic and changing nature. Recent research carried out by Wood *et al.* (2002) suggests that wetlands in Illubabor provide a wide range of environmental goods and services for livelihood portfolios (see Table 1). Combinations of multiple-uses occur in a variety of situations in both small and large wetlands. In some cases, these multiple-uses are complementary, while in other cases they may conflict. In various other situations, they may occur at the same time without affecting each other, they may occur sequentially over time, or they may occur in different parts of a wetland in a spatially segregated fashion. However, of key importance to the discussion at hand, is that all of these stakeholders are dependent on the same wetland ecosystem to obtain the resources necessary for their various livelihood portfolios.

Table 1: Wetland uses and beneficiaries in Illubabor

Uses	**Estimate of Households Benefiting**
Social/ceremonial use of sedges	100% (including urban dwellers)
Thatching sedges	85% (most rural households)
Temporary crop guarding hut of sedges	30%
Dry season grazing	most cattle owners, c 30% of popn
Water for stock	most cattle owners, c 30% of popn
Cultivation	25%
Domestic water from springs	50%-100% (depending on locality)
Craft materials (palm products & sedges)	5%
Medicinal plants	100% (mostly indirectly by purchase from collectors/traditional doctors

Source: Wood *et al*. (2002)

a) ***Natural environment***

The regional ecosystem base of Illubabor Zone provides for a variety of livelihoods strategies, including agriculture, the production of non-timber forestry products (NTFPs), and animal rearing. The region has a climax vegetation of tropical montane forest, but in recent years, much of the forest-cover has been cleared. However, there is still a strong livelihood dependency on NTFPs, including coffee, spices, and sometimes honey. Today the NTFPs are limited to where forest is still present, mainly in the southern areas.

Despite the high rainfall in the area (with 2000mm of rain in a 10 month rainy season at 2000m above sea level), there is a seasonal ‘hungry season’ immediately before the main harvests in October, and a shortage of dry season grazing for livestock, which some 30 % of households own. Agriculture in the region is mostly characterized by an upland farming system of maize and

sorghum cultivation, but there are some more forest-suited systems which are dominated by *ensete*, the false banana. For many farmers, the rich seasonally inundated soils and water availability associated with wetlands provide dry season opportunities for agriculture, particularly for cereal cultivators outside the forest or on the forest fringe. Wetland farmers cultivate predominantly maize, but some vegetables and small areas of sugar cane are planted as well. Wetlands also provide vital income generation opportunities, with a higher proportion of wetland crops (18 per cent) being sold than upland crops (9 per cent sold) (Solomon Mulugeta *et al*.,2000).

Wetlands and their natural resource stocks are thus critically important for communities, where they perform a range of environmental functions and services for local and downstream populations. However, wetlands also play an important role in maintaining regulatory functioning, which is vital to local livelihoods – for example annual flooding helps maintain the soil fertility.

b) ***Infrastructure***

Physical capital – the basic infrastructure, manufactured goods and tools which are required to produce or pursue livelihood strategies – is also a vital component of livelihood portfolios in Illubabor. Since the 1930s, road infrastructure into the region has improved significantly, and this has had a significant impact on local livelihoods. The main driver of road expansion has been the coffee industry, with production occurring both within the forested regions and in plantation areas. Since the early 1960s, the growth of 'coffee towns' has been the consequence of increased trade, and has resulted in a heightened demand for food production. Often, food has had to be imported from other parts of the country to feed the local population, but the growth of coffee towns and urban settlements has also encouraged market-oriented wetland production of maize, and to a lesser extent, vegetables (particularly when food prices increase before the main rain-fed harvest (Solomon Mulugeta, *et al.,* 2000). Increased in-migration into the area – mainly from other parts of the country – has predominantly been a consequence of increased trade, but a major number of rural settlers (equal to 10% of the resident population) were relocated into the area by the government, following the 1984 famine.

c) ***Finances***

Access to economic or financial capital allows individuals and households to make key livelihood decisions concerning investments in natural, human or other forms of assets. Although financial capital remains a vital component of livelihood portfolios, the wide range of wetland stakeholders in the Illubabor Zone means that they are typically of different socio-economic status. It would seem that a minority of the local inhabitants appear to have sufficient access to the financial capital and resources necessary to open up these wetlands – for example, the resources required for hiring oxen or employing labourers to develop wetland areas. As such, a pattern has developed whereby wealthier farmers are able to develop wetlands and generate relatively large amounts of financial capital

through the sale of the crops. This in turn has allowed some individuals to retire from labour intensive work and to diversify their livelihood portfolios by investing in other less stressful enterprises.

However, a considerable number of farmers, such as those who were resettled in the famine, lack the financial capital needed to hire the significant amounts of labour required to develop wetland sites. Many of these individuals are destined to hire out their own labour to wealthier farmers and they lack the capital needed to adequately purchase agricultural inputs. However, some poorer farmers do farm their own wetland plots, albeit on a limited scale. Discussions with these farmers during a recent field work visit to the area revealed that there was great interest in developing further off-farm income generating activities, which would allow them to become more financially self-sufficient and thereby gain access to inputs.

d) Social Capital

The concept of social capital, comprising the informal values, networks, knowledge and rules inherent in a particular society, has been widely explored in rural development research (e.g. see Narayan and Pritchett, 1999; Pretty and Ward, 2001). While social capital may include the processes of communication and innovation that are necessary for new wetland knowledge and practice to evolve (Dixon, 2005), it also constitutes the 'space' in which 'traditional' wetland institutions and organizations exist. Although the concept has been extensively critiqued (Fine, 2001), the significance of social capital, as a key asset in the process of negotiation around institutional wetland arrangements, remains important in understanding how the interconnectedness of people and networks of trust and norms may help wetland communities cope in uncertain times.

Of critical significance for wetland management is the way in which the social capital and relationships of reciprocity that exist between farmers are reshaped by more powerful actors (e.g. either the state or more wealthy stakeholders), and affect the character and strength of community-based institutions. Such institutions, either formal or informal, are based upon a set of rules or procedures that have often developed progressively over time and have been affirmed by community leaders and members (Blunt and Warren, 1996). The co-ordination of activities within a community remains critically important to the management of wetland resources, where one farmer's actions directly affect another's. In this respect, the formation of institutions that govern management behaviour is particularly vital, and reflects the need for co-ordination of activity in working towards a particular goal, which could probably not be fully achieved by individuals alone. Wetland agriculture, especially where drainage structures and water management are involved, is a prime example of a natural resource management activity requiring such coordinated effort.

In the south-west of Ethiopia, wetlands have been subjected to a long history of community management, where social capital has been vital to community co-

operation. Most typically in the Illubabor region, a community committee has been headed by a group called an *Abba Laga* (a term which translates to 'father of the land'). *Abba Lagas* were originally part of the Oromo internal political system long ago, and they were imported to the south-west highlands during the 17th and 18th centuries. However, today, such groups continue to play a critical role in terms of community coordination of wetland management, and the sharing of knowledge and ideas for experimentation. In several localities, these committees, and less formal community groupings, have developed by-laws to restrict wetland cultivation to ensure an adequate supply of sedges for thatching, or else to control grazing to prevent soil compaction and damage to the drainage ditches and sedge beds (Abbot *et al*., 2000). More recently, Wetland Management Coordinating Committees have been developed by communities following the Land Reform period, in response to communities' increased use of these areas. Such decentralized wetland management systems not only reduce the burden on the government, but they also encourage effective local-level monitoring. There is a need to strengthen wetland management control by local communities, and to ensure that local knowledge about sustainable use is given due consideration. Beyond this, as Bakema *et al.* (in press) point out, there is increasingly a need to democratize local wetland management institutions so that they respond to the needs of different interest groups and reflect the needs of all stakeholders. Only in this respect can the socially and ecologically sustainable use of wetlands be achieved within a multiple-use regime.

e) Human Capital

Human capital – the skills, knowledge, ability to provide labour and good health, and the physical capability which allows individuals and households to successfully pursue livelihood strategies – is also vital to wetland livelihoods. Wetland agriculture, particularly clearing and building drainage structures, is labour intensive work that requires a high degree of human capital. Labour cooperation and coordination is necessary to help individuals overcome seasonal food shortages and to develop surplus produce for sale during the 'hungry season' between June and the end of September.

In addition, the knowledge required to successfully develop and manage wetlands is another key component of human capital that is crucial to local livelihoods. For example, the relationship between drainage intensity and sustaining the wetland hydrology is well understood by wetland farmers in Illubabor. Knowledge of wetland processes and an array of management practices based on this knowledge have been developed endogenously since the onset of wetland cultivation in the area (Dixon and Wood, 2003). Dixon (2000) carried out participatory research with wetland communities in the region and discovered that wetland farmers possess extensive and accurate knowledge of the hydrological dynamics of the wetland system, including a detailed understanding of the relationship between rainfall, runoff and water table levels. In many ways, this knowledge – or human capital – can be regarded as the building blocks of wetland management practices, in that the methods of

drainage and crop cultivation have been developed from experience to suit the hydrological conditions in each wetland.

3.3.3. Dynamics of the system

In south-west Ethiopia, wetlands are vital resources for achieving food security and for income generation through the sale of foodstuffs. Wetland cultivation in the Illubabor Zone was initially defined by fringe cultivation and the presence of small supplementary gardens. However, during the early 20th Century, new technology was introduced to the region, most notably the introduction of dendritic drains. For the first time, this in effect meant that entire wetland areas could be drained. This improved the effectiveness of labour use, and also allowed more farmers to gain access to wetland sites.

Access to wetlands in Illubabor further improved after the land reform programme in 1975, but the key constraint on access today has to do with limitations of resources needed for wetland development. Growing population pressure and the migration of famine victims into the area has placed stress on wetland systems, but it has also meant that more people use these areas and have access to wetland sites. Most recently, dynamics have been further altered by road development and the growth of nearby towns and cities. For some farmers who have access to the resources required for larger-scale wetland cultivation, the presence of burgeoning populations in cities has allowed them to increase their production to meet urban demands.

3.3.4. Social sustainability (institutions)

As is apparent from the discussion above, particularly the material which relates to social capital, the social sustainability of wetland management is critical to the success of local livelihoods. Recent work carried out in Illubabor Zone by Dixon (2002) and by Dixon and Wood (2003) has underscored this point, noting that local wetland management institutions play a vital role in co-ordinating the use of wetlands amongst various stakeholders. Such research suggests that local institutions, which are rooted in community social capital, may offer the best (and most sustainable) means to ensure the organization of equitable multiple-use wetland strategies. Because such institutions are democratic, locally based organizations, they have the potential to reduce many social inequalities that are often associated with wetland use by supporting reciprocal labour agreements and access to resources such as oxen and tools. Moreover, local wetland management institutions also have a key role to play in empowering the adaptive capacity of those individuals involved in wetland drainage and cultivation, through supporting the communication and dissemination of wetland information through informal (e.g. meetings) and informal means (e.g. farmer to farmer communications). By facilitating the spread of information linked to wetland-use experiences, both within and between communities, the example of Illubabor

illustrates that wetland institutions can thus help farmers to adapt their management techniques to overcome problems (such as poor crop yields), making wetland management more productive and more sustainable.

3.3.5. Environmental sustainability

Ecological Dynamics

In response to concern over the livelihood impacts of intensive wetland drainage and cultivation, there has been a great deal of research carried out in Illubabor Zone since the late 1990s. Some of this work has focused on identifying various factors that affect wetland utilization and the potential for sustainable wetland management. For example, Wood and Dixon (2002) have shown how different wetland-use regimes, including drainage and cultivation, have varying impacts on the ability of wetlands to provide their environmental functions and socio-economic benefits.

In exploring the effects of drainage on the sustainability of the system, Dixon (2000) found that the major environmental impact was a general lowering of the wetland water table. This, combined with the effects of cultivation, can lead to the physical and chemical degradation of the soil through compaction, oxidization and mineralization. In particular, drainage cultivation for maize appeared to have very significant effects on the wetland, as maize is a crop that needs a high degree of drainage if it is to thrive. In situations where over-drainage has occurred, cattle often enter the wetland to graze, but this further plays a role in compacting the soil.

There is widespread evidence of over-drainage across south-west Ethiopia, as is apparent through the sighting of old drains and lost wetlands across large areas. As excessive draining for agriculture and other livelihood activities (such as Eucalyptus planting and brick-making) has caused water table levels in some areas to fall, this has had a direct impact on the availability of drinking water from local springs around the edges of wetlands. This in turn has led to increased workloads for women, who now must spend greater time and labour collecting water from more distant sources (Wood, 2001). Although it would appear that there is an urgent need for a use regime that ensures the fullest range of benefits are derived from wetlands for the local community in a sustainable way, several studies have demonstrated that the transformation of wetlands can have systemic impacts that are damaging to the interests of various stakeholders, especially marginalized actors such as women and the poor. Simply put, social equity can be, and often is, worsened by wetland development and transformation.

On the other hand, however, there is also reason to believe that wetland agriculture can, in fact, be environmentally sustainable if certain multiple-use strategies are adhered to (practices which many wetland institutions in Illubabor support). The concept of multiple wetland-use remains important as a means of

achieving environmentally sustainable and equitable wetland-use. Because such strategies are based on indigenous knowledge and are rooted in the social capital of the community, they are environmentally and socially sustainable. Multiple-use regimes require a high degree of community coordination, and they recognize the need for sustainable practices including:

- The control of drainage structures, especially at the outlet so as to prevent down-cutting
- The need for a forested catchment to retain water, particularly at the head of the wetland
- Drain depth control and ditch-blocking to prevent the lowering of the water table
- The control of cattle in the wetlands
- Maintenance of the annual flooding regime
- Avoidance of double-cropping with a prolonged drained period
- The encouragement of fallowing in wetlands, with crop rotation if possible

3.3.6. Government policy / Institutional Environment

In recent years, the institutional environment in which strategies for livelihood development are carried out has had a profound effect on local livelihoods. In particular, government policy has had serious impacts on wetland management, both directly and indirectly. Directly, there has been increasing pressure from the government on farmers to cultivate wetlands in order to address regional food security problems. In some cases, this has been characterized by policies which encourage double-cropping in wetlands, a strategy which is ecologically unsustainable. In 2000, the Ministry of Agriculture set up a *Wetlands Task Force* to oversee the expansion of wetland cultivation. Farmers were instructed to drain the areas of their wetlands reserved for sedge (*cheffe*) production, and those farmers who lacked the resources to drain their wetlands had them confiscated by the government. Government policies have clearly conflicted with farmers' indigenous knowledge, and indigenous wetland management coordinating committees have been eroded in the process.

Indirectly, the institutional environment has also had an impact on livelihoods through the introduction of short maturing maize varieties. Although these varieties have increased food output, they have also introduced new stresses by increasing the ability of farmers to cultivate successfully in the wetlands, which has intensified the demand for wetland plots.

3.3.7. A Potentially Sustainable System?

In conclusion, in considering the overall sustainability of livelihood systems in the Illubabor Zone, this case study presents mixed evidence. On the one hand, there is much evidence to suggest that the over-draining of wetlands has resulted in a

failure to sustain wetland cultivation. Moreover, observers have also noted that wetlands are becoming key environmental conflict areas (Dixon and Wood, 2003). Conflict occurs between stakeholders who wish to directly use these areas, and also by those downstream who feel the impacts of alterations in river regimes caused by wetland transformation.

However, on the other hand, other evidence suggests that livelihood systems in the region are indeed sustainable and compatible with one another, where regulatory and provisioning services are balanced. Critical to resolving many of these conflicts is the empowerment of local communities and the raising of awareness and understanding so that local and external knowledge can be used in grass roots level initiatives. It is clear that livelihood portfolios should be guided by multiple-use regimes, which are sustainable both socio-economically and environmentally. Multiple-use systems that take into account the needs of all stakeholders can ensure the maintenance of wetland hydrological functions, while sustaining the production of a range of benefits such as hungry season harvests, dry season grazing, craft and thatching material and medicinal plants (Dixon and Wood, 2003). In short, local-level consultation is vital to future wetland policy formulation if wetland benefits are to be sustained in the long term and the livelihood needs of the entire community are to be met.

3.4. Kalimantan’s peat wetlands

3.4.1. Introduction

Kalimantan, the Indonesian name for Borneo, covers roughly 287,000 square miles and is the third largest island in the world (after Irian Jaya and Greenland). Borneo is subdivided into three countries: Indonesia, which occupies the larger part, Malaysia, and the small, but oil-rich country of Brunei. Indonesian Kalimantan is divided into four provinces: East, West, South and Central Kalimantan (see Figure 6). Given the abundance of rainfall, Borneo's flora is among the most diverse in the world. According to WWF, the island is estimated to have at least 222 species of mammals (44 of which are endemic), 420 resident birds (37 endemic), 100 amphibians, 394 fish (19 endemic), and 15,000 plants (6,000 endemic) – more than 400 of which have been discovered since 1994.

For most of the last millennium, Borneo remained isolated from the rest of the world. Located further from Indian trade routes than other parts of the Malay Peninsula, Borneo was less commonly the destination of traders and immigrants. But in the 16th century, emissaries of Spain and Portugal reached Borneo's shores. Soon after, the Dutch and British arrived, and it was these two latter nations that held power in Borneo from the 17th century until the modern era. In 1949, Indonesia became an independent state, and in 1957, Malaysia gained its independence. Today, the population of Borneo consists of non-Muslim Dayaks and Islamic Malays, as well as Chinese and Europeans.

Borneo is comprised of a variety of different native tribes, each distinguishable from the other by a distinct language and culture. Before contact was made with the West, Borneo's tribes often engaged in wars with one another. Still, the tribes shared a host of similarities, including dwellings, diet, and culture. Today, the Dayak are the largest indigenous group in Borneo; the Iban are also Dayak people and live in the Malaysian parts of Borneo, as well as in Kalimantan[8].

Figure 6. Map of Borneo

Major vegetation types of Borneo. Map modified from WWF's "Borneo: Treasure Island at Risk" report. The map is based on Langner A. and Siegert F.: Assessment of Rainforest Ecosystems in Borneo using MODIS satellite imagery. Remote Sensing Solutions GmbH & GeoBio Center of Ludwig-Maximilians-University Munich, in preparation, June 2005. Based on 57 single MODIS images dating from 11.2001 to 10.2002 with a spatial resolution of 250 m

3.4.2. *Characteristics of the prevailing ecosystem*

For an accurate understanding of Kalimantan livelihood systems – both past and present – information on the larger ecosystem is required. The Kalimantan ecosystem is, in fact, a series of wetlands. It consists of vast tracks of peat swamp covered with forests. Even today, the peat swamp forests are still the dominant ecosystem in the lowlands[9]. The forests thrive on layers of peat, which may be as thick as 15 meters. These swamp forests appear in places where dead vegetation becomes waterlogged and because they are too wet to

[8] source: http://www.pbs.org/edens/borneo/awesome.html and http://www.mongabay.com/borneo.html

[9] Central Kalimantan includes a mountainous range, which divides the island of Borneo into two parts. This range includes the highest peak in Southeast Asia, Mount Kimball, which reaches 4,095 meters (13,435 feet). It is found in the East Malaysian Province of Saba. Obviously, the ecosystems in these mountainous areas are of a different nature.

decompose, they accumulate as peat. The tropical peat lands, formed over thousands of years, are significant stores of carbon. The forests are notoriously inaccessible. The word 'land' may not even be appropriate to describe the land/water mixture on which the forest thrives and the people live.

The peat subsoil makes it difficult to construct anything heavy or permanent. Certainly in the past, road traffic was restricted to areas in and around urban centres, with a few roads connecting urban centres to their hinterlands. Movements of goods and people took place by way of numerous water ways. To give an idea of the enormous size of the peat swamp ecosystems, the following statistics should be appreciated (rounded figures):

Borneo total area: 290,000 square miles, or 750,000 km2, or 75,000,000 ha. Area under peat swamps, in 2002, 10,000,000 ha (Langner and Siegert, 2005, quoted by Rhett A. Butler on: http://www.mongabay.com/borneo.html).

The wet, swampy, virtually inaccessible forests explain the low population densities that have prevailed in Kalimantan for many years: 10 persons/km2, compared to 574 on Java and Madura, and 44 persons/km2 in Sumatra in 1971 (Palte and Tempelman, 1981, p. 53). The supporting base on which the peat swamp ecosystem is build consists of a mix of water and branches and other vegetation material. People had settled along the rivers in places where cultivatable land could be found nearby their houses, and they used the wetlands for hunting, fishing and collecting a wide range of environmental products.

The environmental services that are delivered by this ecosystem are rich. The provisioning services consist of an astonishing variety of food products and fibers, of which a high proportion is important natural capital for the Dayak, Malay and Chinese livelihood systems. For example, livelihoods in a village in Sarawak, Malaysia, were found to depend on 45 different kinds of edible fruits, up to 50 (sic!) kinds of vegetables, and 124 (sic!) plants used for construction, furniture and equipment (Van den Berg, *et al*. 2004). Moreover, not only does the ecosystem provide unique genetic material that is important for biodiversity, but many of the environmental resources have important cultural relevance to the people that inhabit the ecosystem. The size of the ecosystem is so vast that the climate of the larger part of the island is regulated by it. Through transpiration, the forests evaporate large amounts of water, which returns to the land in the form of rain. Moreover, the peat swamps constitute an enormous carbon sink, with the potential to influence climate at a global scale, if the CO2 which it contains is released in the open.

3.4.3. Competing livelihood systems

In this section of the paper, a distinction is made between four main livelihood systems. The first three have been active for many years, and the fourth is a

relative newcomer. The first and the last of these livelihood systems will be subjected to further analysis:

- The Dayak collecting and hunting system
- The Malay permanent crops system
- The Local Chinese Trading system
- The Palm Oil Production system

The people within each of these livelihood systems utilize all five of the capitals available to them - natural, infrastructural, financial, social and human capital. Table 2 contains a qualitative description of the application of the five capitals by each of the livelihood systems[10].

Table 2. Capital characteristics of the five livelihood systems

livelihood system	natural environment	infrastructure	finances	social capital	human capital[1)]
The Dayak collecting and hunting livelihood system	Focus on provisioning services of the ecosystem: Collecting a wide range of forest products, hunting, fishing, some permanent agriculture. Entirely local in orientation.	Simple, until recently hand made tools. Some modern equipment. Houses of the traditional type, along river banks, remote from urban centres.	Relatively few and limited opportunity to acquire goods on markets.	Indigenous people, with a long tradition in the area. Extensive local networks. Limited contact with administration.	Until recently, mostly generation to generation knowledge sharing. Today also modern education until lower levels. Orientation local, or national in exceptional cases.
The Malay permanent crops livelihood system	Focus on provisioning services of the ecosystem: Permanent	Modern, almost exclusively light tools. Houses in villages and	Relatively few and little means to acquire goods on markets,	Well-established immigrants without ties to places of origin.	Modern education, until middle levels. Orientation local, or

[10] Thus far, the necessary research required to describe each of the livelihood systems in detail has not been undertaken. Such research would help to understand how decisions taken in one livelihood system have a direct impact on other livelihood systems and the environment, and most importantly, could shed important light on exactly what the key management decisions should be.

	agriculture and fishing. Broad range of products, but not as broad as that of the Dayak. Entirely local in orientation.	urban centres.	although presumably better off than Dayak. Limited access to formal sources of credit.	Extensive local networks. Limited contacts with administration.	national at best.
The Local Chinese Trading livelihood system	Focus on provisioning services of the ecosystem: Acquisition of a broad range of forest and river products for trading purposes.	Broad range of both light and heavy tools. Houses mostly, but not exclusively in urban centres.	Relatively better off, with good access to formal and informal, local or national, sources of credit.	Well established immigrants, who maintain ties with places of origin. Extensive local networks in all livelihood systems, national and international networks. Intensive contacts with administration.	Modern, until higher levels of education. Orientation also overseas.
The Palm Oil Production livelihood system	Acquisition of products from ecosystems all over the globe, including those from the Central Kalimantan ecosystem, where only one product is obtained (palm oil). Makes use of supporting services of	Much broader and more modern capital layout than any of the groups before, the greater part of which is imported. Light tools, but also heavy tools brought in for special tasks. Houses predominantly in urban centres. If	Own resources, with access to formal and overseas sources of credit.	Individuals live abroad and some immigrants as well. Limited local contacts or contacts exclusively to support acquisition of land and water and other necessary resources. Good contacts with administration.	Higher level formal education.

	the ecosystem.	required, roads and railway tracks built to support natural environmental capital goods.			

Source: Van den Berg, et al., 2004

The livelihood systems of the Dayak people and that of those who are involved in the Palm Oil livelihood system are vastly different. Yet they acquire constituents from the same ecosystem. The Dayak are indigenous people with a strong knowledge of the local environment. The capitals that comprise their livelihood system have been enhanced very little with inputs from the outside world. For example, 13% of the total population of Kampung Tanjung Baru, a village in Sarawak, Malaysia, North Borneo, attended primary school and 7% attended secondary school (Van den Berg, 2004). These extremely low levels of attendance are not any higher in Kalimantan, Indonesia. The Dayak have always lived right in the middle of the peat swamp ecosystem and they have obtained most of their natural environmental capital and infrastructural capital directly from it. The people from the Iban village mentioned above, use 45 different kinds of edible fruits, up to 50 kinds of vegetable, and 124 plants for construction, furniture and equipment. Even their social and human capitals are largely a result of their interaction with the peat land ecosystem. In contrast, the people of the Oil Palm livelihood system originate from other ecosystems and have come to benefit from the services of the peat swamp ecosystem. Many have come from western countries and more recently also from Malaysia and China. Their natural infrastructure capital, financial capital, and even to a large extent their human capital, have all been developed outside the peat swamp ecosystem.

The combinations of capital applied by those whose livelihoods depend on oil palm are essentially different from the combinations of capital applied by the Dayak. An important difference is found in the infrastructure capital. The former have more infrastructure and much heavier equipment. For the first time in the history of the peat swamp ecosystem, it became possible to make a forest area accessible, which was done by lowering the water tables by means of draining off water and by constructing roads[11]. Other heavy equipment was available to cut

[11] There are serious risks involved in draining peat swamps. Draining and/or burning these lands releases tremendous amounts of carbon dioxide into the atmosphere. These drained areas also become highly susceptible to combustion. Under the dry El Niño conditions of 1997-98, thousands of fires raged in the peat swamps of Indonesia. Fires in peat swamps are extraordinarily difficult to extinguish because they can burn for months virtually undetected in the deeper layers of peat. The fires re-occur every year again. They form a hazard for the people of Kalimantan, and also for the people of Malaysia and Singapore. Indeed, air traffic in the region often comes to a complete standstill during the dry season because of the heavy smog. In Central Kalimantan, air traffic can be impossible for weeks.

down trees and remove them from the area. In the process, the ecosystems of deforested areas were heavily compromised.

To obtain the products of the oil palm, it was not the *provisioning* services of the peat swamp ecosystem that were exploited, but rather its *supporting* services. The supporting services are vitally important for other services – provisioning services, regulating services and cultural services (see above, section 2.1). The Oil Palm livelihood system uses the land and water after the forest cover has been removed and excessive water has been drained off. The transformation is so drastic that the original set of provisional regulating and cultural services is entirely replaced by another. As we will see in the following section below, this has significant consequences for social and environmental sustainability.

3.4.4. Dynamics of the socioenvironmental system

For centuries, the peat forests were the arena of one livelihood system: that of the indigenous tribe the Dayak. Two other livelihood systems, those of the Malay and the Chinese, also acquired constituents for human well-being from the same ecosystem, but were not entirely dependent on it[12]. It is probably correct to assume that each of these livelihood systems was sustainable in its social context, in the sense that neither diminished the other (see section 2.2 for the definition of social sustainability). Both were also sustainable ecologically, as they did not deplete or disrupt ecosystems at the expense of the livelihoods and well-being of others (see again section 2.2). In terms of combinations of capitals, strategies for human well-being and interactions with the social and ecological environments, the livelihood systems of the Dayak, Malay and Chinese were very different from each other.

In the late 1970s and 1980s, valuable timber started to be extracted from the forests at an unprecedented rate. To gain access to the most valuable trees, often entire areas of forest were clear-cut. Those responsible for the timber extraction and deforestation were individuals from yet another livelihood system. The livelihoods of these people were not rooted in the peat swamp ecosystem, but rather in other systems in Indonesia and elsewhere. However, they were acquiring constituents for their well-being in the Kalimantan ecosystems. They often were effective in managing their social capital base, in the sense that they had effective contact with the people of the local administration.

In the late 1990s, after the timber boom, the region experienced another boom that was centred on the large-scale production of oil palms. This boom still continues to this day. Recently, demand for oil palm on the international market has increased tremendously, and projections for more robust growth in the years

[12] Livelihood systems do not necessarily coincide with nationalities and people originating from one particular geographical area, and the fact that they do in this case is a coincidence, although other examples where this is the case can be found easily.

to come are firm. Indonesia is the world's second largest supplier of palm oil, after Malaysia, but is expected to become the main supplier in due course. Since the late 1990s, the area under oil palm production has increased greatly in Indonesia, and after Sumatra, Kalimantan is the island where most of the expansion is taking place. In 2006, 1.6 million ha were already under productive oil palm plantations in Kalimantan, with 6 million ha in total for Indonesia as a whole (Colchester, 2006, p. 24) [13]. To give an idea of the size of the oil palm boom, two decades earlier, the area under oil palm production in Indonesia was just 250,000 ha in total.

3.4.5. Social sustainability

In considering present-day livelihood systems in the region, an important question to consider is whether or not indigenous livelihood systems, both past and present, have exhibited sustainability, in the sense that they have been able to cope with and recover from stresses and shocks and maintain or enhance their capabilities and assets. We will consider this question in the context of the Dayak livelihood system. Equally important, however, is the question of whether or not the oil palm livelihood system was sustainable in the social context: did this system enhance or diminish the livelihoods of others?

Access to land is the key factor in explaining the dynamics that took place in Kalimantan's peat swamp ecosystems. The following excerpt describes how the Dayak people traditionally organized access to land by members of their communities:

> The Dayak people's customary system of governing land is … a system that has been applied to their lands for many generations. Land ownership is not ordered through individual titling but is proven, first through demonstrable planted crops or cultivated farmlands, which show that there are people already cultivating and using lands, and, second, through being recorded in the memories of village elders and other respected members of the community. Regulations regarding land transfer and allocation are passed down orally from generation to generation. Boundaries are not physically blazed but derive from known natural signs such as prominent trees, clumps of bamboo, river courses and hills. … Within this territory, lands are allocated from farming to individuals and their families, who secure their rights through clearance and cultivation for their subsistence and income generation. (Colchester, et al., 2006, p. 95).

[13] Possibly part of these oil palms have been planted on land classified as lowland forests; this statistic is theref
It is noted here that all fundamental changes find their origin outside the ecosystems themselves, in the actions of governments and entrepreneurs who make use of possibilities opened up to them by ore not necessarily fully accurate.

Superimposed on this is the system of land allocation by the State. The palm oil companies needed land to accommodate their plantations. Within the framework of existing laws and regulations, land was acquired from the Dayak land holders according to the 7.5 model. This meant that the Dayak land holders each would bring in 7.5 ha of land. In return, they would be entitled to an allocation of 2 ha, on which they could grow palm oils, the products of which they could sell to the company. A condition was that the community would surrender land, including the sites where houses were built, to allow for the plantation to become uninterrupted by other land-use activities. The villagers would be given a new village on a new village site, with good road connections to the surrounding areas. They were also promised schools, a health clinic and other facilities, all to be provided by the company in return for the villagers' land. And above all, they were promised employment opportunities. This procedure, although details may vary, took place in many areas in Kalimantan (and also in Sumatra, the other large Indonesian island where palm oil plantations are prevalent). In this way, plantations were set up that could reach a size of 30,000 ha or more.

The new villages were indeed constructed, but villagers often still complain that the facilities have yet to be realized. The employment opportunities appear to be less abundant. Instead of the 2 ha of land that were promised to them, the families received 1.2 ha on average. Villagers complain that the palm oil company officials were not transparent in their dealings with the villagers. Villagers also state that individual profit seeking has replaced traditions of communality and solidarity, and the customary, more collective, mode of life (Colchester, *et al*., 2006, p. 101). Incomes have improved, but less than expected. Road connections have improved. The areas for planting crops have been cleared, and this has caused changes in species distribution and abundance. There are reports of uncontrolled pests. Bush fires are used to get rid of dried, cut down vegetation every dry season, with wide spread smog as a consequence.

It is clear from this account that the answer to the first of the two questions – whether the Dayak people, or the Dayak livelihood system, were able to cope with and recover from the stresses and shocks they experienced, and whether they were able to maintain or enhance their capabilities and assets now and in the future – must be negative. The answer to the second question, whether the oil palm livelihood system enhanced and did not diminish the livelihoods of others, is negative as well. There is an urgent need for a study to be carried out that would systematically compare the combinations of capital types before and after the land transfer. It is likely that such a study would conclude that the traditional Dayak livelihood system would not be possible any more. The oil palm livelihood system has been unsustainable in the social context: it has diminished the Dayak livelihood system.

4. Summary and interpretation

Dynamic socioenvironmental systems, including wetland systems, are often affected by human interventions (see section 2). These interventions can take the form of a wide range of human-induced activities, such as crop cultivation, fishing, or hunting and gathering. The social aspect of such systems concerns the relationships between all individuals involved in interventions. These people are not necessarily only local or of indigenous origin, but may also come from elsewhere; they may have their roots in other, possibly far away ecosystems. Many of these systems, including wetlands, are highly dynamic socioenvironmental systems; many are often sites of conflict between different groups of people seeking access to one or more of the services that the environmental systems have to offer. Individuals living in and around wetland systems depend on their services in order to acquire constituents for their well-being. Examples of such constituents include food, fiber, and other products that a wetland system can offer. The term socioenvironmental system was first applied by the Millennium Assessment team in 2005, and most notably in Chapter 3 of the MA report. Much of the conceptual framework used in the present paper builds on the ideas and concepts introduced in the MA reports.

Although wetlands provide vital livelihood resources for a wide range of actors, there is often conflict between wetland stakeholders. These various stakeholders are distinguished by the fact that they each have different aims, focus on different resources, products or services, and utilize different technologies and strategies in their wetland management regimes. They may also be distinguished from one another by their levels of skill and knowledge, and how this was obtained. In accordance with the MA reports, the term ‘livelihood system’ is thus used to describe a system that an identifiable group of people use to acquire certain benefits from an ecosystem. Or as our definition suggests: “a system operated by a person, or individuals linked together because of their shared aim, to acquire constituents for individual well-being within a specific ecosystem.’ Three important conclusions are derived from this discussion.

- Where there are different groups of people active in an ecosystem, such as a wetland system, and each makes an effort to acquire access to certain products, resources of services, we speak of different livelihood systems in operation;
- Livelihood systems can be indigenous, but they may also be systems that originate outside the boundaries of the wetland system proper;
- Consumers of the products and services of a wetland system are part of the livelihood system that generates them.

The last two statements lead to another important conclusion: livelihood systems can stretch over great geographical distances. This is the case, for instance, if

the product acquired in a specific ecosystem is transported over large distances to be consumed by individuals elsewhere. An example of such a situation might include tuna fish that is caught in the Atlantic Ocean and consumed in Western Europe.

A livelihood system is sustainable if it can cope with and recover from stresses and shocks, and maintain or enhance its capabilities and assets now and in the future. The literature on livelihoods also emphasizes the interrelationship of different livelihood systems with each other and the environment:

- A livelihood is sustainable in a social context when it enhances or does not diminish the livelihoods of others; and
- A livelihood is sustainable in an ecological context when it does not deplete or disrupt ecosystems at the expense of the livelihoods and well-being of others, now or in the future.

Section 3 describes three 'real world' situations, each one very different from the other. In comparing these three case studies, one notable difference concerns the variability in the size of the systems. The valley head or upper valley wetlands in the Illubabor region, Ethiopia, measure 5 to 50 ha. In comparison to the peat swamp wetland systems of Kalimantan, Borneo, they are significantly smaller wetlands. Alternatively, the Kolleru wetland system has an area that varies with the seasons. In the summer, its area may be as small as 50 km2, whereas in the peak monsoon flows, it can extend to 900 km2.

Another striking difference between the three studies concerns the moment in time at which the systems began to undergo dynamic change, after having remained stable for centuries. Conditions in the Kolleru Lake system started to change fundamentally in the mid-nineteenth century, when the British colonial government introduced irrigation works to prevent the reoccurrence of a dramatic food shortage among the population. Conditions changed once again when the government allowed government land to be turned into fish ponds and tanks, and again when all aquaculture was banned. Fundamental changes in the Illubador case occurred when land reform was initiated during the 1960s. In Kalimantan, changes took place even later in the 1980s, when timber was extracted from the peat swamp forest on a large scale and was then replanted with oil palm on land that was deforested[14].

In comparing these three very different case studies, the question remains as to whether or not the concepts summarized above can be applied to interpret these

[14] It is important to note here that all fundamental changes find their origin outside the ecosystems themselves, in the actions of governments. In the case of the Kolleru lake, India, and the Kalimantan peat swamps, entrepreneurs are involved who make use of possibilities opened up to them.

situations in a way that improves our understanding. In particular, it remains important to note three relevant questions:

- Can the concept of livelihoods be applied in a meaningful way so as to understand these three differentiated studies?
- In each case, are livelihood systems sustainable in a social context? And,
- In each case, are livelihood systems sustainable in an ecological context?

The first question is not very difficult to answer. In the case of the Kalimantan peat swamps, and in the Kolleru basin case, it is easy to identify the different livelihood systems that have played a role in the dynamics of the situations. A livelihood system is successful if the people involved aim for specific constituents to continue or enhance their well-being, employ specific strategies, etc. This is clearly the case with the Dayak, and the people involved in oil palm production in Kalimantan, Indonesia. It is also the case with the Dalits and the Vaddits, the indigenous peoples of the Kolleru basin, and later with the fishpond entrepreneurs. The livelihood systems in the Illubabor region in Ethiopia seem to be less well defined, at least the case is described in terms of the people acquiring different constituents and producing for themselves or for the markets.

The question of whether the timber livelihood system or the oil palm livelihood system is sustainable in a social context is difficult to answer, although the evidence available suggests that they are probably not. In the areas where the peat swamp forest has been cleared and replaced by oil palms, the Dayak livelihood system has not been enhanced. On the contrary, many livelihoods appear to have diminished. It would seem that Dayak people are poorer than they were before the changes occurred. The constituents for well-being are no longer available, since the ecosystem has changed so fundamentally: the old combinations of capital have become meaningless in the new situation, the social relations are of a different nature and each person works for himself/herself, etc. The same conclusions are valid for livelihood systems of the Kolleru Lake. As the traditional diversified livelihood systems have shifted to intensive agriculture and subsequently aquaculture led systems, the gradual dominance of market led livelihoods has increased, enhancing the vulnerability of traditional communities with limited economic and social capital to exploit the opportunities. With gradual reduction in coping mechanisms, the communities have been forced to migrate. Traditional community governance systems based on centuries of trust have been diminished and fragmented. Overall, the well-being of these communities has greatly diminished and led to increased poverty.

Only the traditional wetland livelihood systems in the Illubabor zone in Ethiopia appear not to have diminished in importance and relevance for the people who depend on them. However, the tendency for local actors to diversify livelihood portfolios is widespread, and it would seem that strong, local wetland management institutions play a vital role in coordinating the use of wetlands amongst various stakeholders. Moreover, research suggests that these local

institutions, which are strongly grounded in social capital, are critical in ensuring the organization of sustainable multiple-use wetland strategies. Wetland livelihood systems appear to have been able to cope with many of the dramatic changes which have taken place in the region in recent years. For these conclusions to be drawn more firmly, however, more research is required. Such research must start with developing criteria that make it possible to measure 'enhanced', 'diminished', and livelihood systems that have 'ceased to exist'.

A livelihood system is sustainable in the ecological context when it does not deplete or disrupt ecosystems, to the detriment of the livelihoods and well-being of others, now or in the future. The cases of the Kolleru lake, India, and the valley bottom wetlands in Illubabor, Ethiopia, contain data that make it possible to draw conclusions that concern the ecological sustainability of the developments. In the case of Kolleru Lake, the intensification of agriculture and aquaculture has been supported through progressive fragmentation of the wetland regimes. Natural flow regimes have been modified to support freshwater dependant systems leading to tremendous decline in biodiversity. The flood attenuating capacity of the wetlands have been greatly reduced due to sedimentation and construction of flow impeding structures, enhancing waterlogging in upstream stretches and consequent damages to crops and property. Changes in hydrological regimes have also led to prolific growth of invasive species (*Eichhornia crassipes, Salvinia ariculata* etc.), impacting native species and overall biodiversity. In the case of the Illubabor zone, once again, it is apparent that the concept of multiple-use remains at the heart of achieving environmentally sustainable and equitable wetland-use. These multiple-use regimes require a high degree of community co-ordination, and they recognize the need for sustainable practices. When livelihood regimes are guided by multiple-use regimes, it is possible for a wide range of actors to live sustainably and compatibly with one another, where regulatory and provisioning services are balanced.

5. Relevance for the Ramsar Guidelines

The concepts of human well-being, livelihood systems, capital combinations, livelihood strategies, and social and ecological sustainability, have proven to be powerful tools for analyzing and deepening our understanding of what is actually going on in the wetland system case studies presented in this paper. More importantly still, these concepts have also proven to be useful constructs for assessing whether certain developments or dynamics are sustainable in the social and ecological context. Ultimately, however, it remains crucial that these concepts are translated into a set of guidelines – the Ramsar Guidelines on agriculture-wetland interactions – which can be used by decision-makers at the local or national level, in assessments of the dynamics of any agriculture-wetland system.

In sum, this part of the Ramsar Guidelines for agriculture-wetland interactions would serve two purposes:

1. Analyses of current situations and developments

Such a set of Guidelines should consist of a series of questions and sub-questions which can assist individuals – members of the target group – in making decisions that are both ecologically and socially sustainable. Below are some examples of the more generally formulated questions that should certainly feature in the Guidelines. Such questions would be useful in focusing on a particular agriculture-wetland system and could be utilized by decision-makers with a responsibility towards that agriculture-wetland system:

I. Which livelihood systems make use of the resources of the agriculture-wetland system at present? Which constituents do they attempt to acquire from the agriculture-wetland system?
II. What combinations of capital – natural, physical, financial, social, and human – are available to the stakeholders of each livelihood system? What is the relative strength and position of each livelihood system?
III. What are the strategies of the stakeholders in each livelihood system for acquiring constituents? What right of access do they have to which capitals? How do they mediate their claims and are they effective in doing so?
IV. Are the strategies of each livelihood system socially sustainable? To what extent is there competition for the same constituents? In seeking to acquire constituents, what do the actions of individuals in one livelihood system mean for the efforts of those individuals in other livelihood systems who seek to acquire the same constituents?
V. Are the strategies of each livelihood system ecologically sustainable? What do the actions by the people of a livelihood system to acquire

constituents in an ecosystem mean for the ecosystem's capacity to deliver services?

VI. What is the institutional environment - government structures, policies, laws, markets, cultural practices and institutions - in which the strategies for livelihood development are carried out?

It is important to stress that, by definition consumers are part of a livelihood system. Their position and actions, or lack of them, should be part of the analyses.

2. Risk Assessment

The situation or developments in a particular agriculture-wetland ecosystem can be classified as socially or ecologically sustainable or unsustainable. Although at times it remains difficult to determine the exact criteria of what is socially or ecologically sustainable, the questions I-VI outlined above could be useful in guiding analyses which seek to generate conclusions in terms of the sustainability of situations or trends. But further work is needed to link such conclusions to concrete management actions. In taking such work forward, there is an urgent need for suggestions on how to regulate the agricultural activities of an active livelihood system so that a balance in ecosystem services derived from the wetlands is not altered.

In addition there is the issue of scale in the Guidelines, or the level at which certain questions should be addressed. For the moment, two scales are distinguished:

- The scale at which water is a key issue in all management decisions in agriculture-wetland interactions. This is the catchment, or the agriculture-ecosystem system proper;
- The scale at which trade and incentive systems are defined, and national policies are formulated. This is often at the national level.

There is one issue that was often implicitly covered in the forgoing pages, yet that needs to receive explicit attention in the Guidelines. This is the issue of incentive systems and pricing mechanism. Many incentive systems and pricing mechanisms, which often were introduced as part of some government policy, adversely impacted wetland ecosystem services, as they often failed to internalize the economic value of the wetland ecosystem services. The guidelines should endorse a systematic assesment of economic values of ecosystem services and encourage their integration into the design of incentive systems.

The ultimate challenge of the Guidelines under preparation is therefore to recognize changes in livelihood systems as triggers for unsustainable changes in

either the ecosystem services in a wetland-agriculture system, or in other livelihood systems.

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